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METHOD OF FABRICATING BRAGG GRATINGS USING A SILICA GLASS PHASE GRATING MASK AND MASK USED BY SAME

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CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part application of U.S. application Serial No. 07/811,299, filed December 20, 1991, now U.S. Patent No. 5,216,739 which is a continuation-in-part application of U.S. application Serial No. 07/656,462, filed February 19, 1991, now U.S. Patent No. 5,104,209.

FIELD OF THE INVENTION

This invention relates to optical media such as optical fibers, and particularly to a method for fabricating Bragg gratings therein.

BACKGROUND TO THE INVENTION

Certain optical fiber waveguides exhibit the property of photosensitivity which provides a practical means for photoinducing permanent refractive index changes in the core of those fibers. Photosensitivity is not restricted to fiber structures: it has also been detected in several types of planar glass structures, including, for example, silica-on-silicon and ion-implanted silica waveguides devices.

The fabrication of optical waveguide devices such as intra-mode retro-reflecting Bragg gratings, mode convertor gratings, and rocking rotators have been achieved. The general approach for making these devices is to photoinduce a refractive index grating in the photosensitive core of the optical waveguide. The grating consists of a periodic modulation of the core's refractive index along the length of the waveguide. The period of the perturbation is chosen to bridge the momentum (propagation constant) mismatch between the two (normally bound) modes that the grating is designed to couple. At the resonant wavelength of the structure, phase-matched, efficient, power exchange between the coupled modes is possible.

There are two basic methods used for photoinducing gratings in photosensitive optical fiber waveguides: either by internal or by external writing. Internal writing is usually a holographic process where the modes to be coupled are launched as coherent bound modes of the waveguide and are allowed to modify, by a two-photon absorption process the refractive index of the waveguide core (i.e. form the hologram). Subsequent launching of one mode "reconstructs" the other. The activation wavelength for writing gratings internally in Germanium-doped high-silica glass is in the visible band (for example, at the 514.5 and 488.0 nm Argon-ion laser wavelengths) with corresponding two-photon energy in the U.V. band. External writing uses UV light directly (for germanium doped high-silica fiber, UV light tuned to, or in the vicinity of, the oxygen vacancy absorption band at 240 nm) incident from the side on the optical waveguide. External writing can be accomplished point-by-point, for mode convertor gratings, or using the holographic interference of two coherent UV beams for Bragg retro-reflectors.

Index gratings were first written in optical fibers using a technique described by K.O. Hill et al and disclosed in U.S. Pat. No. 4,474,427. The process requires launching into the core of a Ge-doped fiber strand light having a wavelength in the visible region. The light is reflected from the end of the fiber. The forward propagating light interferes with the backward propagating light to form a standing wave pattern with a period corresponding to half the wavelength of the writing light. Through a photosensitive effect in the fiber, a refractive index grating with this period is written in the core of the fiber. With this technique, only gratings can